Synthesis of 2D and 3D Gold Nanoarrays and Semiconductor Nanoparticles in Supercritical Fluid Carbon Dioxide

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Abstract

Metal and semiconductor nanoparticles of controllable size can be synthesized using microemulsion as template in different solvents. Two types of microemulsions have been studied using bis(2-ethylhexyl)sulfosuccinate (AOT) and a fluorinated AOT as surfactant for making water-in-oil and water-in-CO_2 microemulsions, respectively. Chemical reduction of metal ions (e.g. Au^{3+}) dissolved in the water core of a microemulsion leads to the formation of metal nanoparticles (e.g. Au^{o}) with size controllable by the dimension of the water core and the solvent surrounding the microemulsion. By mixing two microemulsions one containing Cd^{2+} and the other containing S^{2-}, CdS nanoparticles of different sizes can be synthesized using the microemulsion-template method. Binary CdS/ZnS nanoparticles can also be synthesized using this method. Because the salvation strength of supercritical fluid CO_2 is tunable by varying temperature and pressure, we are developing techniques for synthesizing metal and semiconductor nanoparticles of controllable sizes using water-in-CO_2 microemulsions as template. The synthesized nanoparticles can be stabilized using an alkanethiol compound. Self-assembling of thiol-stabilized gold nanoparticles has been shown to result in ordered 2D and 3D arrays with sizes in micrometer dimensions. Characterization of these nanoparticles and nanoarrays are currently in progress.